

Focal Species: Hawai‘i Island Honeycreepers

‘Akiapōlā‘au (*Hemignathus munroi*)

Hawai‘i Creeper (*Oreomyza mana*)

Hawai‘i ‘Ākepa (*Loxops coccineus*)

Synopsis: These three endangered and specialized honeycreepers are endemic to the island of Hawai‘i. They have similar, highly fragmented ranges and face similar threats. The ‘Akiapōlā‘au has a unique “Swiss army knife” bill that is used as both a chisel and forceps to extract prey from wood. The ‘Ākepa has an asymmetrical bill with crossed tips that are used to pry open leaf buds to obtain tiny caterpillars. These species are restricted by mosquito-borne diseases to cold, high-elevation native forests, but global warming may increase the range of mosquitoes and threaten their last refugia. Many areas of native forest have been degraded, and habitat restoration and management are important conservation actions.



‘Akiapōlā‘au male. Photo Eric VanderWerf



Hawai‘i ‘Ākepa male. Photo Eric VanderWerf



Hawai‘i Creeper. Photo Jack Jeffrey

Geographic region: Hawai‘i Island
Group: Forest Birds
Federal Status: Endangered
State status: Endangered
IUCN status: Endangered
Conservation score, rank: 19/20, At-risk
Watch List 2007 Score: RED
Climate Change Vulnerability: High

Population Size and Trend:

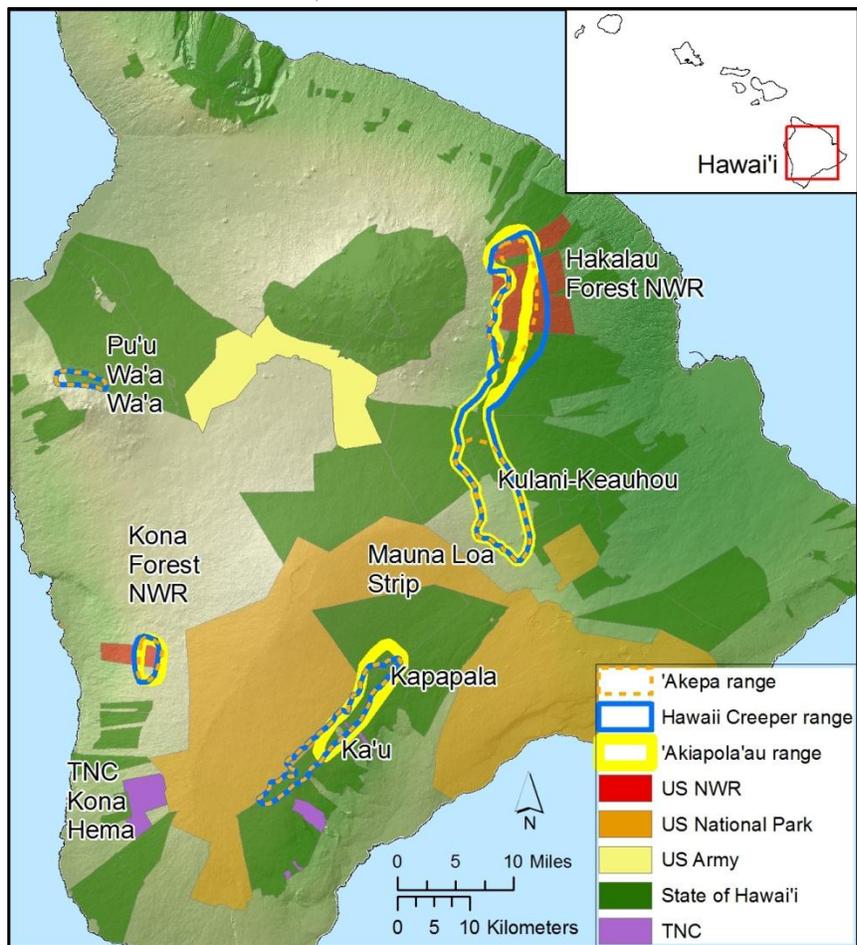
‘Akiapōlā‘au – The total population is estimated to be 1,900 birds. The largest numbers are found at Hakalau Forest National Wildlife Refuge (NWR) and in the upper portions of the Ka‘ū Forest Reserve (FR), where trends are increasing and stable, respectively (Camp et al. 2009, 2010). The Kūlani-Keauhou area in the central windward region of the island also supports a high density of birds, but their trend is not clear because of variable estimates and inconsistency in survey effort (Gorresen et al. 2009). Populations on leeward Mauna Loa are declining at best and are possibly extirpated (Camp et al. 2009, Gorresen et al. 2009).

Hawai'i Creeper – The total population is estimated to be 14,000 birds. The largest numbers are found at Hakalau Forest NWR and in the upper portions of the Ka'ū FR, where trends are increasing and stable, respectively (Camp et al. 2009, 2010). Populations are likely declining in the central windward area and populations on the leeward side of Mauna Loa are dwindling and are relictual at best (Camp et al. 2009, Gorresen et al. 2009, Pratt et al. 2010).

Hawai'i 'Ākepa – The total population is estimated to be 12,000 birds. Numbers are thought to be stable or increasing at Hakalau Forest NWR, which supports approximately half of the entire population, though there has been debate about the status of this population (Camp et al. 2010, Freed and Cann 2010). The Ka'ū FR supports the second largest population, but variable density estimates make determining a trend difficult. Numbers in the central windward area of the island may be decreasing. Populations on the leeward side of Mauna Loa are very small and declining (Camp et al. 2009, Gorresen et al. 2009, Pratt et al. 2010).

Range: The ranges of these three species overlap broadly, with larger populations occurring on the windward (eastern) slopes of Mauna Kea and Mauna Loa. Their ranges are much smaller on the leeward (western) slopes, where all three species are declining or extirpated (Camp et al. 2009, Gorresen et al. 2009, Pratt et al. 2010). Historically, these species occupied all forested regions on the island (Lepson and Freed 1997, Pratt et al. 2001, Lepson and Woodworth 2002).

'Ākiapōlā'au – Occurs in three disjunct populations, mostly between 1,500 and 2,000 meters (4,875–6,500 feet) elevation: 1) Mauna Kea and Mauna Loa, including Hakalau Forest NWR and the Kūlani-Keauhou area; 2) the Ka'ū and Kapāpala areas in the southern part of the island; and 3) a small population on leeward Mauna Loa at the Kona Forest NWR, which may be extirpated (Fancy et al. 1996, Camp et al. 2009). A subalpine population on western Mauna Kea has been extirpated since 2004.



Hawai'i Creeper – Occurs in four disjunct populations above 1,500 meters (5,000 feet) elevation (Camp et al. 2009): 1) northern and central windward region, including Hakalau Forest NWR

and Kūlani-Keauhou; 2) the Ka‘ū and Kapāpala forest reserves; 3) the central Kona region including the Kona Forest NWR, and 4) Pu‘u Wa‘a Wa‘a Forest Bird Sanctuary on Hualālai (Camp et al. 2009, Pratt et al. 2010).

Hawai‘i ‘Ākepa – Occurs in five disjunct populations all above 1,300 meters (4,300 feet) elevation (Camp et al. 2009): 1) northern windward Mauna Kea, including Hakalau Forest NWR; 2) Kūlani-Keauhou in the central windward region; 3) the Ka‘ū-Kapāpala region on the southeastern slope of Mauna Loa; 4) the central Kona region, including the Kona Forest NWR; and 5) Pu‘u Wa‘a Wa‘a Forest Bird Sanctuary on Hualālai (Pratt et al. 2010).

Essential Biology:

‘Akiapōlā‘au – The ‘Akiapōlā‘au is a stocky Hawaiian honeycreeper endemic to the island of Hawai‘i and is famous for its unique and specialized bill. Males are bright yellow on the head and underparts, yellow-green on the back and wings, with a small black mask. Females are olive above with grayish-yellow to yellow underparts (Pratt et al. 2001). The song is a long complex warble and calls include a loud “chu-weet” that is louder and huskier than other honeycreepers.

The ‘Akiapōlā‘au occurs primarily in mesic and wet montane forests dominated by ‘ōhi‘a (*Metrosideros polymorpha*) and koa (*Acacia koa*) (Fancy et al. 1996), but it also uses regenerating koa forests >10 years old (Pejchar et al. 2005), and until recently it occurred in subalpine dry forests consisting of māmane (*Sophora chrysophylla*) and naio (*Myoporum sandwicense*) trees (Pratt et al. 2001). ‘Akiapōlā‘au forage on branches of koa, kōlea (*Myrsine lessertiana*), māmane, and naio trees, tapping branches with their thick lower bill to locate prey. Once a food item is located, the lower bill is used like that of a woodpecker bill to chisel a hole. The long, thin decurved upper bill is then used to extract the prey. The upper mandible also is used to probe cracks and crevices. ‘Akiapōlā‘au are primarily insectivorous, with lepidoptera larva, spiders, and beetle larva being the most important prey items (Pratt et al. 2001). The ‘Akiapōlā‘au is also unique among passerine birds in that drinks sap from holes it excavates in ‘ōhi‘a trees (Pejchar and Jeffrey 2004).

This species is characterized by low annual productivity and high adult survival. Pejchar et al. (2005) found that over a two-year period pairs raised an average of 0.96 fledglings. The open cup nest is most often placed in an ‘ōhi‘a tree. Clutch size is usually one, rarely two, and females perform all incubation and brooding. Males provide females and nestlings with the majority of food. Fledglings are dependent on their parents for four to five months, and family groups consisting of hatch-year and second-year young have been observed. Breeding has been documented year-round, although most activity occurs from February to July. The ‘Akiapōlā‘au often associates with mixed-species flocks after breeding, which also may include the Hawai‘i ‘Ākepa, Hawai‘i Creeper, and Hawai‘i ‘Amakihi (*Hemignathus virens*; Hart and Freed 2003). Pejchar et al. (2005) found that territory size varied with habitat structure and amount of koa, with smaller territories in koa plantations (11.7 ha) and intact forest (12.3 ha) than in forest degraded by cattle grazing (23 ha), and that territory overlap was greater in koa plantations, leading to higher population density.

Hawai‘i Creeper – The Hawai‘i creeper is a small, inconspicuous Hawaiian honeycreeper endemic to the island of Hawai‘i. Adult males and females are olive-green above, dull buff below, and have a dark gray mask around the eyes. Their similarity to Hawai‘i ‘Amakihi, Hawai‘i ‘Ākepa, and the introduced Japanese White-eye (*Zosterops japonicus*) complicates field

identification (Lepson and Woodworth 2002). The song is a descending trill that is often given several times in a row.

The Hawai'i Creeper occurs in mesic and wet montane forests dominated by 'ōhi'a and koa; highest densities are found in old-growth forests (Lepson and Woodworth 2002). It forages for insects, spiders, and other invertebrates on large or medium-size branches, mostly on koa and 'ōhi'a, but also on pilo (*Coprosma* spp.), 'ōlapa (*Cheirodendron trigynum*), naio, and kāwa'u (*Ilex anomala*).

The nesting season is from February-June (VanderWerf 1998, Woodworth et al. 2001). Most nests are open cups, but about 15 percent are placed in cavities or in bark crevices. The female builds the nest, incubates eggs, and broods nestlings. The male delivers food to the female on and off the nest. Both parents feed the young for approximately one month after fledging. Hawai'i Creepers re-nest after failures and pairs have been documented raising two broods in a season. Nest success of Hawai'i Creepers is low (VanderWerf 1998), but adults have high annual survival (Woodworth et al. 2001). During the breeding season the species' home range averages 4-7 hectares (10-17 acres) in size and a 10-20 meter (33-66 feet) territory around the nest is defended (VanderWerf 1998). Outside the breeding season, Hawai'i Creepers frequently join mixed-species foraging flocks (Hart and Freed 2003) and forage over home ranges that average 11 hectares (VanderWerf 1998).

Hawai'i 'Ākepa – The Hawai'i 'Ākepa is a small (9 g), insectivorous Hawaiian honeycreeper now restricted to the island of Hawai'i. 'Ākepa formerly occurred on Maui (*L. c. ochraceus*) and O'ahu (*L. c. rufus*), but those subspecies are extinct. Male 'Ākepa exhibit delayed plumage maturation, obtaining their bright orange adult plumage after three years (Lepson and Freed 1995). Females are grayish green with a yellow breast band. The lower bill of the Hawai'i 'Ākepa is slightly curved to one side, resulting in a crossed bill, a characteristic shared with the 'Akeke'e (*L. caeruleirostris*). The lower bill may be curved to the left or right, and, depending on the direction of the bill curve, individuals also possess an accompanying leg asymmetry; the leg opposite the curve in the bill is slightly longer than the other leg. Together, these adaptations likely improve the species foraging efficiency. The song is a high, descending trill, with repeated element that rise and fall, giving a lilting effect (Lepson et al. 1997).

The Hawai'i 'Ākepa occurs in mesic and wet montane forests dominated by 'ōhi'a and koa; highest densities are found in old-growth forests (Freed 2001). The species forages almost exclusively on the terminal leaf clusters of 'ōhi'a and among koa leaves and seed pods, where it uses its crossed bill to pry open leaf and flower buds in search of small arthropods, mostly spiders and caterpillars. This species is characterized by low annual productivity and high adult survival (Hart 2001).

'Ākepa are obligate cavity nesters, with most nests placed in natural cavities found in old-growth 'ōhi'a and koa trees (Freed 2001); artificial nest boxes have been used rarely. The nesting season is from March-June. The female builds the nest, incubates eggs, and broods nestlings, and the male delivers food to the female on and off the nest (Lepson and Freed 1995). Both parents feed the young, which remain with their parents for two to three months after fledging. Most breeding activity occurs between March and June. Hawai'i 'Ākepa often join mixed-species foraging flocks, particularly those with Hawai'i Creepers (Hart and Freed 2003).

Primary Threats: These three species share similar threats but their severity varies among the species according to their biology. The smaller population size of the 'Akiapōlā'au renders it

more vulnerable to random demographic fluctuations and localized catastrophes such as volcanic eruptions, fires, disease outbreaks, and, potentially, genetic inbreeding.

- Habitat loss and degradation. Cutting of native forest for logging, cattle ranching, and silviculture of non-native trees has reduced the amount of native forest habitat and fragmented it in many areas. Most areas of native forest important to these species have been legally protected in some way, but some “protected” areas receive little or no management and habitat degradation by invasive plants and non-native ungulates remains a problem. Habitat fragmentation may hinder natural re-colonization by these species into unoccupied but suitable habitat. The ‘Akiapōlā‘au may be less limited by habitat loss than the other two species because it will forage in relatively young koa (Pejchar et al. 2005). ‘Ākepa are more vulnerable to habitat degradation because they are obligate cavity nesters, and their population density may be limited by availability of cavity nest-sites, which form only in large, old-growth ‘ōhi‘a and koa trees (Freed 2001). In forest fragments, the large trees required for nesting by ‘ākepa may be more susceptible to windfall and desiccation. Koa is relatively fast-growing, but slow growth of ‘ōhi‘a limits regeneration.
- Invasive non-native plants. Invasive plants have invaded native forests and reduced habitat quality in virtually all areas of the island. Some of the worst invasive plants are strawberry guava (*Psidium cattleianum*), blackberry (*Rubus argutus*), gorse (*Ulex europaeus*), banana poka (*Passiflora mollissima*), holly (*Ilex aquifolium*), Christmasberry (*Schinus terebinthifolius*), fire tree (*Morella faya*), kahili ginger (*Hedychium gardnerianum*), kikuyu grass (*Pennisetum clandestinum*), fountain grass (*Pennisetum setaceum*), and *Eucalyptus* spp. The more common honeycreeper species may forage in non-native plants, but these three rare, specialized honeycreepers are restricted to native forest.
- Non-native ungulates. Browsing by feral cattle (*Bos taurus*), feral sheep (*Ovis aries*), and mouflon sheep (*O. musimon*) has degraded habitat quality in many areas and hindered recruitment of native trees. Rooting and wallowing by feral pigs (*Sus scrofa*) has destroyed understory vegetation in many areas, hindered recruitment of native trees, and provided breeding sites for mosquitoes that carry diseases. The axis deer (*Cervus axis*) was illegally released on Hawaii in 2011; this alien species has caused serious damage to native habitats on Maui and is able to jump over fences that exclude other ungulates.
- Diseases. Avian malaria (*Plasmodium relictum*) and avian poxvirus (*Poxvirus avium*), transmitted by the non-native southern house mosquito (*Culex quinquefasciatus*), limit the distribution of many Hawaiian forest birds (Warner 1968, van Riper et al. 1986, Atkinson and LaPointe 2009). The malarial parasite and mosquito larvae develop more slowly at colder temperatures, restricting sensitive bird species to cold, high elevation refugia. The ‘Akiapōlā‘au, Hawai‘i Creeper, and Hawai‘i ‘Ākepa are rare or absent below 1,350 meters (4,500 feet), suggesting they are particularly susceptible to mosquito-borne diseases.
- Non-native Predators. Predation is a threat to many Hawaiian forest birds, particularly their nests, but there is little direct evidence of predation on these species. At least three nests of the Hawai‘i ‘Ākepa in low cavities are known to have been depredated by rats (P. Hart, unpubl. data), and it is possible that other inaccessible nests have been depredated. In other Hawaiian forest bird species, predation has been documented on nests by non-native black rats (*Rattus rattus*) and feral cats (*Felis silvestris*) (Fancy et al. 1996, Laut et al. 2003, VanderWerf 2009). Young birds that cannot yet fly well are also vulnerable to small Indian mongooses (*Herpestes auropunctatus*) and Barn Owls (*Tyto alba*).

- Competition with Non-native Species. Competition for food with non-native birds and invertebrates may be a threat, but the evidence is not clear. Freed and Cann (2009) argued that competition with the Japanese White-eye (*Zosterops japonicus*) has negatively affected growth and survival of native birds, particularly the Hawai'i 'Ākepa. Yellow jackets wasps (*Vespula pennsylvanica*) also may compete for food with these insectivores.
- Climate Change. An increase in prevalence of avian malaria in response to increasing temperatures has already been reported at Hakalau Forest NWR (Freed et al. 2005). Global climate change will likely continue to exacerbate the threat of disease by increasing the elevation at which regular transmission of avian malaria and avian pox virus occurs (Reiter 1998, Benning et al. 2002, Harvell et al. 2002, Atkinson and LaPointe 2009b).

Conservation Actions to Date: The 'Akiapōlā'au, Hawai'i 'Ākepa, and Hawai'i Creeper were listed as endangered under the U.S. Endangered Species Act in 1967, 1970, and 1975, respectively, and also are listed as endangered by the State of Hawai'i. Hakalau Forest NWR was acquired in 1985 specifically to protect habitat for these endangered honeycreepers and other forest birds and supports the largest populations of all three species. The second largest populations in the Ka'ū and Kapāpala areas have been provided varying degrees of protection by the Kahuku section of Hawai'i Volcanoes National Park and the Ka'ū and Kapāpala forest reserves. Other important habitat has been protected by the Kona Unit of the Hakalau Forest NWR, the Ola'a-Kilauea Management Area, and the Pu'u Wa'awa'a State Forest Bird Sanctuary. At Hakalau Forest NWR, over 500,000 native trees have been planted to increase forest area, especially at higher elevations of the refuge. Other restoration and management actions at Hakalau have included fencing almost half of the refuge, removal of all feral ungulates, and control of invasive alien plants. Habitat management including fencing, ungulate eradication, limited predator control, forest restoration, and habitat monitoring also has been conducted by the National Park Service, Hawai'i Natural Area Reserve System, Three Mountain Alliance, Mauna Kea Forest Restoration Project, Mauna Kea Watershed Alliance, and The Nature Conservancy of Hawai'i. Research with conservation implications has been conducted on demography, habitat use, disease, and other topics by the USGS Biological Resources Division, the University of Hawai'i at Manoa and Hilo, and other groups (van Riper et al. 1986, VanderWerf 1998, Woodworth et al. 2001, Hart 2001, Freed 2001, Jarvi et al. 2004, Freed et al. 2005, Pejchar et al. 2005, Woodworth et al. 2005, Foster et al. 2007).

Planning/Research Needs:

- Investigate whether these species are developing disease resistance in the lower-elevation portions of their ranges. Evolution of malaria resistance has been documented in the Hawai'i 'Amakihi (Woodworth et al. 2005, Foster et al. 2007).
- Determine if genetic markers or specific phenotypes are associated with disease resistance or tolerance. If disease-tolerant individuals can be identified, they could be used in translocations to establish new populations or to augment existing populations that lack disease tolerance.
- Investigate why populations of all three species have declined or disappeared on the Kona side of the island.
- Determine feasibility of translocating each species to managed areas in their former ranges, such as Pu'u Wa'awa'a Sanctuary, the Mauna Loa strip section of Hawai'i Volcanoes National Park, the Kona Forest NWR, and TNC's Kona Hema Preserve.

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- Conduct studies to further examine habitat selection and foraging ecology, particularly for the ‘Akiapōlā‘au in regenerating koa forests.
- For the Hawai‘i ‘Ākepa, expand studies of artificial nest cavities to determine cavity type preferences, whether preferred artificial cavity types can be made rat-resistant, and evaluate their potential to facilitate range expansion and establishment of new populations.
- Improved monitoring, including more frequent surveys, mist-netting and banding, and nest monitoring, would help to improve ability to measure population trends and efficacy of conservation actions.

5-Year Conservation Goals:

- Continue and expand native forest restoration and management to include all areas that are important to these species by ensuring that existing fences are maintained, constructing new fences, removing feral ungulates, and controlling invasive alien plants.
- Acquire or legally protect and then manage additional areas of high elevation native forest.
- Devise methods of minimizing or mitigating the effects of climate change on these species, particularly the anticipated increase in transmission of mosquito-borne diseases.
- Increase public support for forest bird conservation through outreach.

Conservation Actions:

- Habitat Restoration. Manage forest habitat by fence construction and maintenance, feral ungulate removal, control of invasive alien plants, and outplanting of native species.
 - Repair fences and remove feral pigs from all management units at Hakalau Forest NWR. Hakalau was formerly pig-free but fences were not adequately maintained because of funding and staffing shortfalls and pigs reinvaded, compromising decades of habitat restoration work.
 - Continue forest restoration at Hakalau Forest NWR. Over 500,000 trees have been planted at Hakalau since 1987, mostly koa, and the earliest plantings are now being used by endangered honeycreepers.
 - Fence parts of the Ka‘ū FR that support endangered forest birds, eradicate ungulates, control weeds, and outplant native species. Ka‘ū supports the second largest populations of these endangered honeycreepers, but the habitat has been degraded and is in need of management (State of Hawai‘i 2012).
 - Eradicate ungulates, control weeds, and outplant native species in the Kahuku section of Hawai‘i Volcanoes National Park adjacent to the Ka‘ū FR.
 - Remove ungulates, control invasive plants, and outplant native species in the part of the Kona Forest NWR that was fenced in 2012.
 - Remove feral ungulates and banana poka and other invasive plants from Pu‘u Wa‘a Wa‘a State Forest Bird Sanctuary. This area supports important remnant populations of Hawai‘i Creeper and Hawaii ‘Ākepa, but the habitat has been degraded.
 - Restore forest connectivity on eastern Mauna Kea by fencing and removing ungulates in the Kanakaleonui corridor owned by the Department of Hawaiian Homelands between Hakalau Forest NWR and Palila Critical Habitat. The ‘Akiapōlā‘au occurred in this area until the 1990s, restoring a connection could allow natural range expansion.
- Habitat Protection. Support acquisition of McCandless Ranch lands currently for sale adjacent to the Kona Forest NWR.

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- Disease. Removing pigs will reduce disease prevalence by decreasing suitable breeding habitats for mosquitoes.

Summary of 5-year Actions, 2013-2017:

Conservation Action	Year(s)	Annual cost	Total Cost
Fence repair/replacement, inspection, and maintenance at Hakalau Forest NWR	1-5	\$200,000	\$1,000,000
Remove feral pigs from fenced units of Hakalau Forest NWR	1-5	\$500,000	\$2,500,000
Control invasive plants at Hakalau Forest NWR	1-5	\$200,000	\$1,000,000
Build fence (~35 km) in Ka'ū FR	1-3	\$1,100,000	\$3,300,000
Remove feral ungulates from Ka'ū FR and begin habitat management (~4,850 ha)	2-5	\$450,000	\$1,800,000
Remove feral ungulates from Kona Forest NWR	1-3	\$150,000	\$450,000
Control invasive plants at Kona Forest NWR	1-5	\$85,000	\$425,000
Remove ungulates from Pu'u Wa'a Wa'a FBS	1-3	\$75,000	\$225,000
Control invasive plants at Pu'u Wa'a Wa'a FBS	1-5	\$85,000	\$425,000
Continue habitat restoration at TNC Kona Hema Preserve	1-5	\$150,000	\$750,000
Restore forest in the Kanakaleonui corridor on Mauna Kea	1-5	\$300,000	\$1,500,000
Artificial nest box study for Hawai'i 'Ākepa	1-3	\$100,000	\$300,000
Surveys to better monitor species status and trend	1, 3, 5	\$75,000	\$225,000

Potential Partners: U.S. Fish and Wildlife Service, U.S. Geological Survey Pacific Island Ecosystems Research Center, Hawai'i Division of Forestry and Wildlife, Hawai'i Natural Area Reserves System, Department of Hawaiian Homelands, Three Mountain Alliance, Kamehameha Schools, and The Nature Conservancy of Hawai'i.

Ancillary Species: Management that would benefit these species also would benefit all native bird species that use forest habitat on the island of Hawai'i, including the Hawaiian Hawk or 'Io (*Buteo solitarius*), Pueo or Hawaiian short-eared Owl (*Asio flammeus sandwichensis*), Hawaiian Crow or 'Alalā (*Corvus hawaiiensis*), Hawai'i 'Elepaio (*Chasiempis sandwichensis*), 'Oma'o (*Myadestes obscurus*), Hawai'i 'Amakihi, 'I'iwi (*Vestiaria coccinea*), and 'Apapane (*Himatione sanguinea*).

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